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## (54) IMPROVEMENTS IN OR RELATI NG TO A SCREW EXTRUDER FOR SYNTHETIC PLASTICS MATERIAL


(71) I, GERHARD HANSEN, a German citizen, of D7161 Laufen am Kocher, Heerberg 87, do hereby declare the invention,

for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a screw extruder for plastics with a screw in a housing, having a filling opening in its filling section.

Attempts have been made to increase the output of low and high-speed screw extruders. It has been shown that differing screw configurations have only a limited influence, but that the output can be significantly increased if the receptive capacity of the screw extruder is increased.

According to the present invention there is provided a screw extruder for synthetic plastics material comprising a body defining a bore, a filling aperture leading into the bore and a screw mounted for rotation in the bore, the cross sectional area of the bore adjacent the filling aperture being of larger cross sectional area than that of the remainder and the screw being disposed concentrically within this larger part of the bore so as to leave a space between the screw and the wall of that part of the bore, which is greater in radial extent than the clearance between the screw and bore wall in the remainder of the body and which is substantially constant in radial extent for the length of the filling aperture.

It has been shown to be advantageous to have a constantly narrowing transition section from the extension in the filling section to the remainder of the housing, said transitional section subjecting the synthetic plastics material granulate passing from the filling section to the remainder of the housing to preliminary compression as the space becomes radially narrower. This results in a significant increase in the output.

An additional significant increase in the output capacity of the extruder may be obtained by providing at least one rib in the filling section, said rib having a part parallel to the axis of the housing, extending longitudinally beyond the filling section and having a height which is not greater than the difference in radial dimensions between the extension and the remainder of the bore.

In order that the invention may be more fully understood, one embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings in which:—

Fig. 1 shows a longitudinal section of the screw extruder,

Fig. 2 shows the filling section illustrated in the longitudinal section on a larger scale,

Fig. 3 shows a plan view of the filling section shown in Fig. 2, and

Fig. 4 shows a section along line IV—IV in Fig. 2.

Referring to the drawings the screw extruder for plastics has a housing 1 and a screw 2. The housing 1 has a filling section 3 attached removably thereto, on which a hopper 4 is placed. An extruder die 5 is attached to the housing 1 on the end remote away from the hopper 4.

The screw 2 has a drive journal 6, a seal 7, a feed section 8, a compression section 9, a homogenising and metering section 10 and a conical tip 11, which extends into the extruder die 5. The diameter of the seal 7 corresponds to the inside diameter of the adjacent section of the housing 1. The screw extends from sections 8 to 10, having its smallest diameter in the feed section 8 and its largest in the metering section 10, with a tapered transition in the compression section 9.

Section A of the screw extruder comprises the metering section 10 of the screw, section B its compression section 9 and section C its feed section 8. Sections A, B and C are designated the homogenising metering zone, compression zone and inlet or feed zone respectively.

The filling section 3 illustrated in Figs. 2 to 4 has a filling opening 21 of substantially rectangular cross section connected to the hopper 4. The length of the filling opening 21 is approximately 1.5 to twice the outside

diameter of the screw. In the vicinity of the opening 21 is a larger diameter section 22 which is between 15% to 25% greater in diameter than the remainder of the bore. If the diameter of the seal is 45 or 60 mm (1.77 or 2.36 in), the section 22 has a diameter of 55 or 70 mm respectively (2.17 or 2.76 in). The radial increase of the section 22 over the remainder of the bore is generally selected so as to represent approximately twice the diameter of a granule. The granules can roll around in the section 22 while the screw is in operation to assume favourable positions for being tightly compressed. The length of the section 22 is equal to or slightly greater than the length of the filling opening 21.

On the side remote from the seal, the section 22 and the filling opening 21 are followed by a tapered transition at section 23 having an angle of taper of 30°, for example from the smaller to the larger diameter sections of the bore. The corresponding zone D of the screw can be designated a pre-compression zone. On the inside of the housing 1 from the filling section 3 to about the start of the homogenising or metering section 10 of the screw 2 are defined longitudinal grooves 12, which oppose a rotary movement of the plastics granulate advanced by the screw 2. The cross section of the longitudinal grooves 12, which are 4 to 12 mm (0.16 to 0.47 in), in particular 5 to 10 mm (0.20 to 0.39 in), deep, depending on the nature of the synthetic plastics material to be processed and the size of the screw, is triangular, with one side of the triangle extending radially. The angle, remote from the screw 2 and formed by the walls of the longitudinal grooves 12, is approximately 60°. The radial walls of the longitudinal grooves are arranged in such a manner relative to the direction of rotation of the screw 2 that the plastics material advanced by the screw 2 is pressed against these walls. The longitudinal grooves 12 extend to a point approximately one screw channel upstream of compression zone B.

Located on the inside of the filling section 3 in the vicinity of the section 22 is a rib 24, which extends inward radially to the inside diameter of the seal 7. The radial extension or height of the rib, however, can also be somewhat smaller. The output of the screw I depends on the height of the rib 24, so that with differing heights of the ribs, differing outputs can be achieved with otherwise unchanged conditions. Thus, the output of a screw extruder can be altered by either changing the rib 24 or changing the filling section 3 for one with a rib of a differing height.

The rib 24 can extend parallel to the longitudinal axis of the housing I, but is preferably arranged at an angle to the horizontal plane containing the longitudinal axis, an acute angle of 30° has been shown to be favourable. The rib 24 preferably extends the entire length of the section 22 and the transition 23, where it ceases. As can be seen from Fig. 4, the rib, as viewed in the direction of rotation of the screw 2, has on its front side a bevelled contact surface 25 which is followed by a face 26 extending radially and on its rear side a face 27 extending radially. The rib 24 extends from the seal 7 to the transition 23 and its spiral extent between these two points is approximately a quarter circle. It is located in such a manner that the end disposed in the area of the transition 23 is tangential to the filling opening 21 (Fig. 4). Displaced 180° relative to the rib 24 is a further rib 24*a*, having the same pitch as the rib 24 and extending into the filling opening 21. The design of the inner surface of this rib 24*a* corresponds to the rib 24 and the outer surface projecting into the filling aperture is rounded. The rib 24 and the rib 24*a* oppose a rotary movement of the plastics granulate in the section 22.

The rib 24 and the rib 24*a* are welded to the filling section 3, but can also be attached differently, for example, interchangeably. In the area of the section 22, both ribs extend like a helix.

The section 22 and the rib 24 and/or 24*a* can be mounted on low and high-speed screws and are intended particularly for high-speed screws. A high-speed screw with an inside housing diameter of 60 mm (2.36 in) and a screw length of approximately ten times the inside diameter of the housing would provide an output of approximately 130 kg (287 lbs) per hour using the prior-art extruder which does not have the section 22 and the rib 24 and/or 24*a*, while if an extruder designed according to the invention were employed, the output would be increased to approximately 360 kg (794 lbs) per hour, with the design otherwise the same. The rotary speed of the screw was 500 rpm in both cases. With a filling section 3 having both the transitional section 23, with the section 22 and the rib 24 in the section 22 approx. 50% of the increase in output results from each of these measures. The section 22 alone also results in an increase in the output over a screw extruder of the same type not having this section in its filling section.

An enclosed channel arranged in a spiral manner can be provided in the screw housing for cooling, the channel extending over the area of the longitudinal grooves 12 and somewhat beyond it. The coils of the spiral of the cooling channel can be located relatively close to one another. The cooling prevents the granulate located in the longitudinal grooves from plasticizing prematurely and rotating relative to the housing 1. As long as the pre-compressed granulate is carried in the longitudinal grooves, its rela-

tion to the screw 2 is the same as a nut screwed on a thread which is held on its outside as the thread rotates.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It should therefore be understood that within the scope of the appended claims, the invention may be practised otherwise than as specifically described.

WHAT I CLAIM IS:—

1. A screw extruder for synthetic plastics material comprising a body defining a bore, a filling aperture leading into the bore and a screw mounted for rotation in the bore, the cross sectional area of the bore adjacent the filling aperture being of larger cross sectional area than that of the remainder and the screw being disposed concentrically within this larger part of the bore so as to leave a space between the screw and the wall of that part of the bore, which is greater in radial extent than the clearance between the screw and bore wall in the remainder of the body and which is substantially constant in radial extent for the length of the filling aperture.

2. A screw extruder according to claim 1, in which the body also defines a tapering transitional section joining the part of the bore adjacent the filling aperture to the downstream remainder of the bore.

3. A screw extruder according to claim 1 or 2, in which a rib projects from the internal surface of that part of the body defining the bore adjacent the filling aperture, the degree of projection being not more than the amount that the radial dimension of the bore adjacent the filling aperture exceeds the corresponding radial dimension of the remainder of the bore and the rib extending at an angle to the longitudinal axis of the extruder.

4. A screw extruder according to claim 3, in which a portion of a rib extends into the filling opening from the transitional section.

5. A screw extruder according to claim 3, in which the rib extends in the form of a helix.

6. A screw extruder according to any preceding claim, in which cooling channels are located in the body from the area of the filling aperture to a compression zone.

7. A screw extruder as claimed in any preceding claim, wherein the diameter of the bore is between 15% to 25% greater adjacent the filling aperture than the diameter of the remainder of the bore.

8. A screw extruder as claimed in claim 2, or in any of claims 3 to 7 when appendant to claim 2, wherein the transitional section tapers at an angle of 30° from the smaller to the larger diameter sections of the bore.

9. A screw extruder as claimed in claim 2, 8 or in any of claims 3 to 7 when appendant to claim 2, wherein the inner surface of the smaller diameter section of the bore defines axially extending grooves adjacent the transitional section.

10. A screw extruder to claim 9, wherein the grooves are of triangular construstion in cross section, one side of the triangle extending in the radial direction.

11. A screw extruder according to claim 4 or 5, wherein the rib comprises a surface inclined to the radial direction in the vicinity of the inner periphery of the filling aperture and a surface leading radially therefrom.

12. A screw extruder according to claim 11, wherein the rib comprises a radially extending surface on its surface opposite to the inclined surface.

13. A screw extruder for synthetic plastics material substantially as hereinbefore described with reference to the accompanying drawings.

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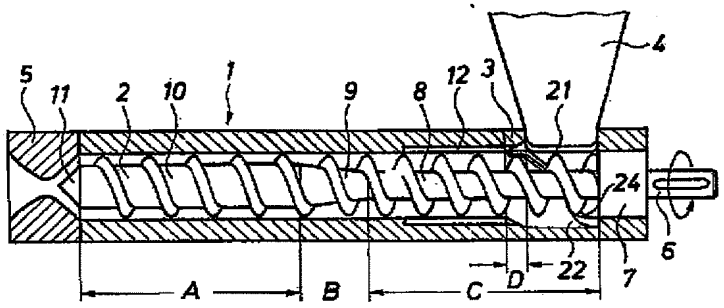


*Fig. 1*

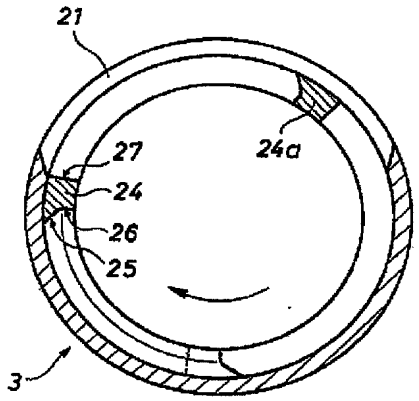


*Fig. 4*

1422731 COMPLETE SPECIFICATION
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Sheet 2

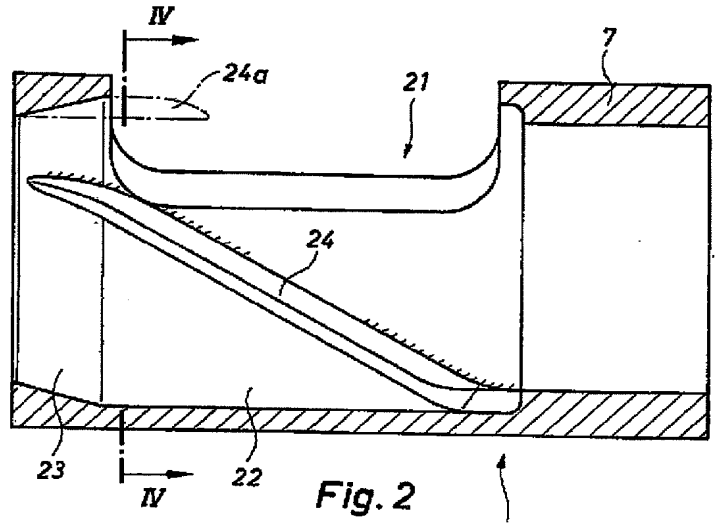


Fig. 2

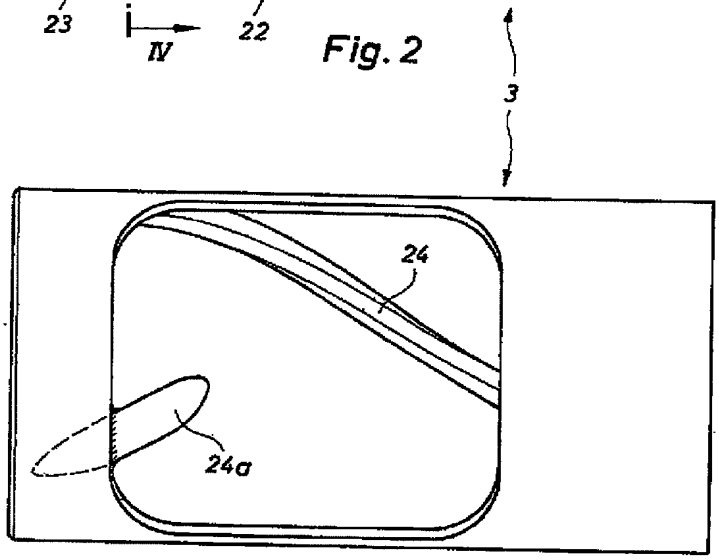


Fig. 3